

## 9 Chapter 9: Cost and Schedule

### 9.1 Detector Scope

The Work Breakdown Structure (WBS) for construction of MINERvA is outlined schematically in Figure 1. The project WBS and management structure parallels the project budget structure. Infrastructure to the MINERvA Hall for MINERvA (or any other experiment) and installation of the MINERvA detector in the MINERvA Hall are outside the scope of the baseline MINERvA Project.

The cost estimate presented in this Section is a very brief summary of the detailed information given in the MINERvA Project Cost and Schedule Plan (CSP). It is based on the baseline detector design described in the earlier Chapters of this Technical Design Report.

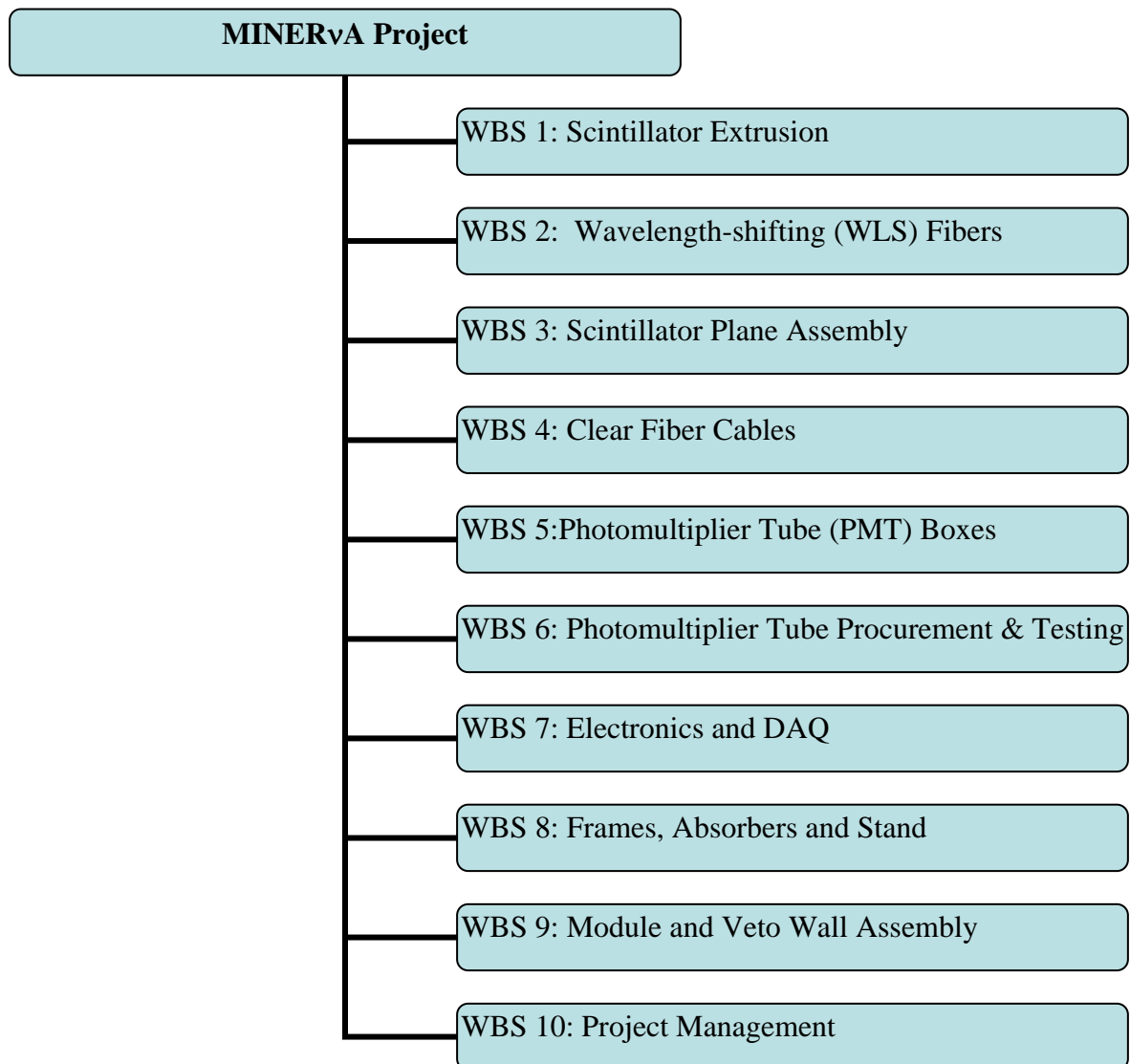


Figure 1: Overview of MINERvA Work Breakdown Structure, to Level 2

## 9.2 Cost Estimate Summary

The MINERvA Collaboration has and continues to focus substantial effort on value engineering. The MINERvA Project has implemented a design review system, in which each major subsystem is closely examined to obtain optimal value for the system, given the technical requirements and schedule constraints imposed on it. A summary of value engineering efforts on the MINERvA Project are given in <http://minerva-docdb.fnal.gov:8080/cgi-bin/ShowDocument?docid=329>.

The MINERvA detector is rather similar to the MINOS detector and thus many cost estimates were based on MINOS experience and/or time and motion study results and construction procedures based on MINERvA R&D experience. Bottoms up cost estimates were developed by the MINERvA Level 2 managers in conjunction with people who have done similar work before. These cost estimates were then reviewed by Project Management and entered into the MINERvA CSP. Detector costs at WBS Level 2 are summarized in [Table 1](#). The column labeled M&S shows the base costs (including all indirects but no contingency) associated with purchased Materials and Services for the Total Estimated Cost (TEC) (or Major Item of Equipment, MIE). This includes university Labor and M&S. The Labor column shows the base costs (including all indirects but no contingency) for all Fermilab skilled labor used in fabrication, assembly, and testing (TEC). The Contingency columns (% and \$) show the weighted average contingencies in dollars and as percentages of the total cost respectively. The Total Cost column shows the total cost in as spent as year dollars. Totals for the R&D Off Project Costs (OPC) portion of the project total about 4.4M\$ all in M&S in as year base dollars, and 6.0\$ in base plus contingency. Finally, the Total Project Cost (to DOE) or TPC is given where the TPC is the sum of the TEC and the OPC.

WBS	Items	MINERvA's Cost Estimate AYk\$									
		Base w/Indirects			Contingency %			Contingency \$			Total Base w/Indirects and Cont.
		M&S	Labor	Total	M&S	Labor	Total	M&S	Labor	Total	
M I E	1.0 Scintillator Extrusion	121	268	\$ 389	19%	25%	23%	\$ 24	\$ 67	\$ 90	\$ 480
	2.0 WLS Fibers	350	374	\$ 724	30%	21%	25%	\$ 104	\$ 80	\$ 183	\$ 907
	3.0 Scintillator Plan Assembly	208	655	\$ 864	48%	29%	34%	\$ 99	\$ 192	\$ 292	\$ 1,155
	4.0 Clear Fiber Cables	358	727	\$ 1,085	30%	37%	35%	\$ 109	\$ 267	\$ 376	\$ 1,461
	5.0 Photomultiplier Tube Boxes	148	395	\$ 543	21%	30%	28%	\$ 31	\$ 119	\$ 150	\$ 693
	6.0 Photomultiplier Tubes	1,114	194	\$ 1,308	33%	37%	34%	\$ 367	\$ 72	\$ 439	\$ 1,747
	7.0 Electronics and DAQ	922	101	\$ 1,024	35%	40%	35%	\$ 322	\$ 41	\$ 363	\$ 1,387
	8.0 Frames, Absorbers, Coil and Detector Stand	418	133	\$ 552	31%	28%	30%	\$ 129	\$ 37	\$ 166	\$ 718
	9.0 Module and Veto Wall Assembly & Installation	180	238	\$ 398	37%	20%	27%	\$ 60	\$ 49	\$ 108	\$ 506
	10.0 Project Management	62	1,230	\$ 1,292	163%	30%	36%	\$ 101	\$ 369	\$ 470	\$ 1,762
	Total MIE:	3,862	4,316	\$ 8,178	35%	30%	32%	\$ 1,346	\$ 1,291	\$ 2,637	\$ 10,815
OPC	R&D	1,587	2,794	\$ 4,382	41%	35%	37%	\$ 648	\$ 985	\$ 1,633	\$ 6,015
	Total OPC:	1,587	2,794	\$ 4,382	41%	35%	37%	\$ 648	\$ 985	\$ 1,633	\$ 6,015
	TPC:	5,449	7,110	\$ 12,559	37%	32%	34%	\$ 1,994	\$ 2,277	\$ 4,271	\$ 16,830

**Table 1 Baseline cost of the MINERvA Project in \$AYk.**

Detector funding is primarily through the Fermilab MINERvA Project, using funds provided by the US DOE and Fermilab. There is an NSF contribution to the construction of the detector Light Injection (LI), Module Mapper and Nuclear Target systems of approximately [\\$300K](#). The value of the expected NSF contribution, including the [20%](#) contingency allowance, is not included in the total cost estimates in the second

to last line of [Table 1](#). The MINERvA cost estimate includes an average contingency of [34%](#).

The estimated total (non-NSF) Total Project Cost (TPC) of the MINERvA detector including contingency is [\\$16.8M](#) in as year dollars including contingency. [Table 2](#) shows the change control approval levels for MINERvA. Further cost details are available in the MINERvA Project CSP.

Change Control Approval Thresholds for MINERvA				
	Level 1	Level 2	Level 3	Level 4
<b>Authority</b>	Acquisition Executive / SC – Associate Director	Federal Project Director	Fermilab Associate Director for Research	Fermilab MINERvA Project Manager
<b>Technical</b>	Any change in scope that affects the mission need requirements	N/A	Any change that affects the scientific goals, technical baseline, or ES&H requirements as defined in the PMP	Any change in the scope as described in the Technical Design Report
<b>Cost</b>	Any increase in the TEC or TPC	Accumulated use of contingency above 100k\$	Accumulated use of contingency above 100k\$	Any use of contingency
<b>Schedule</b>	Any change to level 1 milestones	Any change to level 2 milestones	Any change greater than 6 months to level 3 milestones	Any change greater than 2 weeks to level 3 milestones

**Table2: Change control levels for the MINERvA Project.**

### 9.3 Schedule Summary

The overall project schedule is shown in [Figure 2](#). The summary task durations represent the time from the beginning of the first task to the completion of the last task. Much more detailed schedules are available in the CSP. The Project critical path is shown in [Figure 3](#). The project has two critical paths. One is through PMT testing and PMT boxes, the other is through scintillator plane assembly. These two paths are intentionally balanced by the Rochester pre-purchase in FY07 of several items critical to start PMT box production.

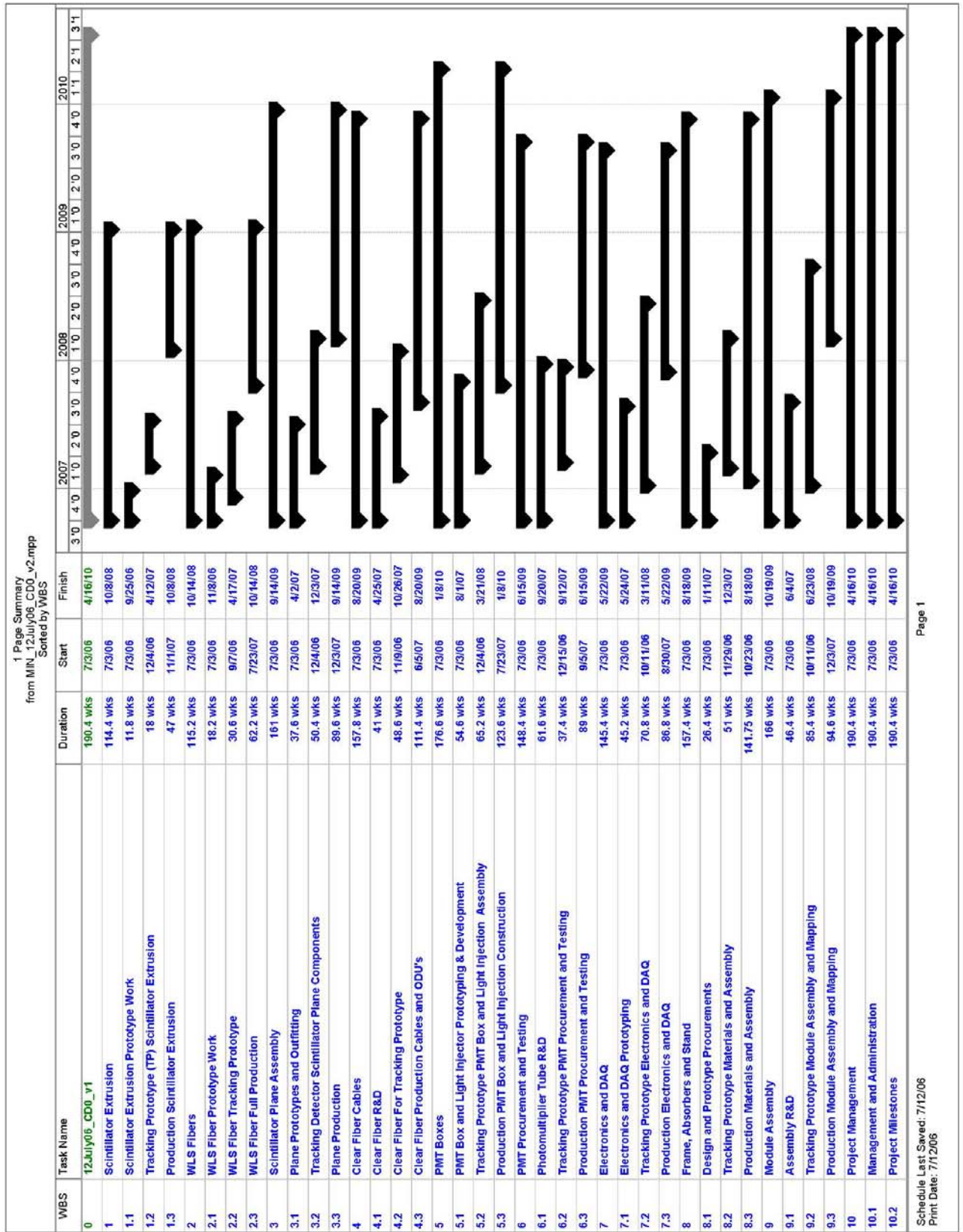


Figure 2: MINERvA Project Schedule Overview

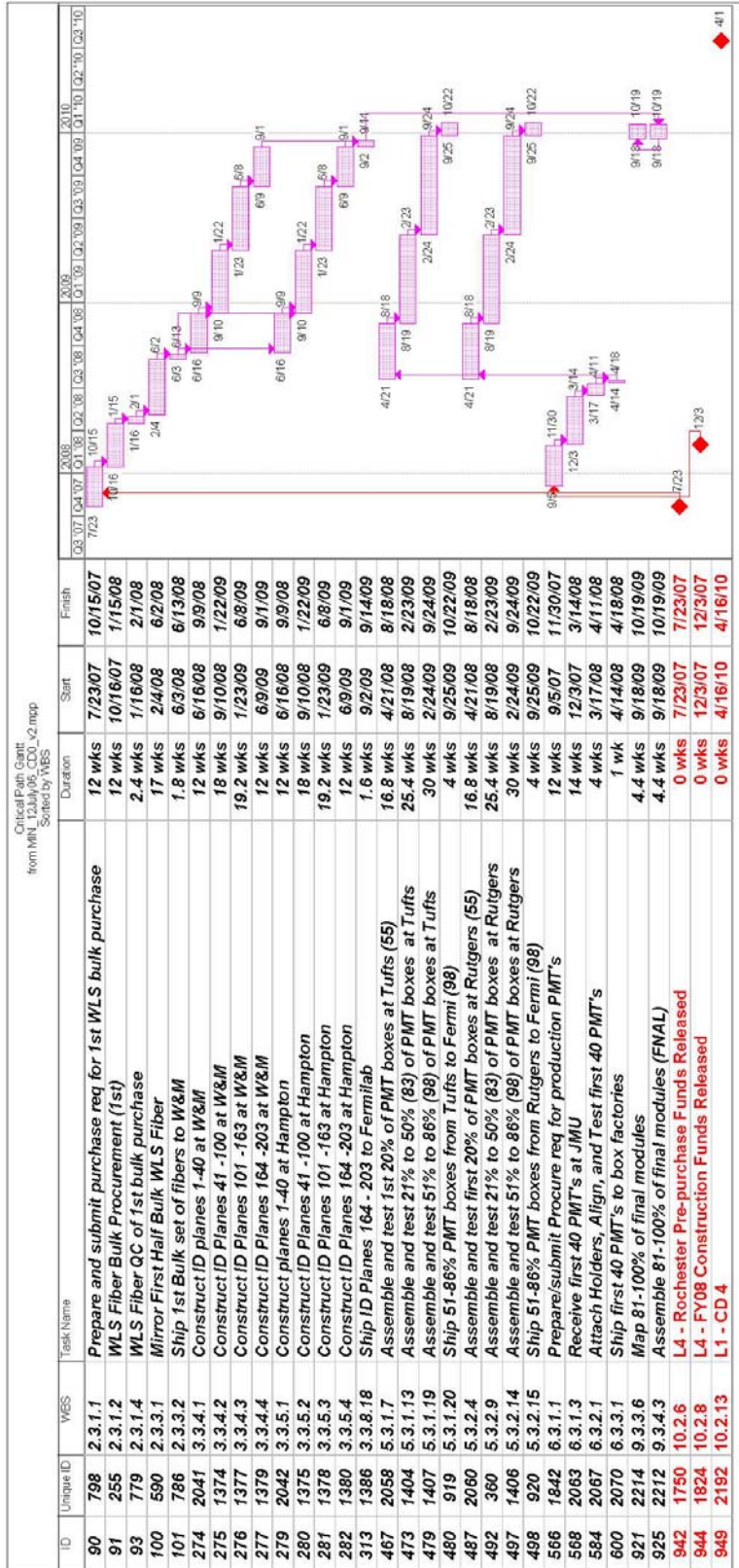


Figure 3: MINERvA Project Critical Path



## 9.4 Funding Profile

The draft baseline funding profile for MINERvA (in thousands of As-Year dollars) has been established and is shown in [Table 3](#), where it was understood that the costs for FY10 would be included in the costs listed for FY09, and the costs for FY07 (the pre-purchase costs) would be paid back in FY08. [Table 4](#) shows the MINERvA funding profile from the CSP. The TEC portion agrees to 200k for the first two years but due to a cost increase the guidance for the FY09 funds would only cover FY09, not FY09 and FY10. The R&D portion is roughly 400k more in each of FY07 and FY06. R&D costs incurred after CD-0 (defined as July 1, 2006) are categorized as Other Project Costs (OPC). A contribution totaling 0.3M\$ is provided towards project deliverables from the National Science Foundation from the Major Research Instrumentation (MRI) Program: The Total Estimated Cost (TEC) + the OPC are combined to give the Total Project Cost (TPC) to the DOE.

	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	Total
Total Estimated Cost (TEC)	0.0	0.0	5.3	4.7	0.0	10.0
Other project cost (OPC)	0.7	4.1	0.4	0.0	0.0	5.2
Total DOE project cost (TPC)	0.7	4.1	5.3	4.7	0.0	15.2

Table 3: Draft Baseline Funding Profile for the MINERvA Project

	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	Total
Total Estimated Cost (TEC)	0.0	0.3	5.1	4.9	0.5	10.8
Other project cost (OPC)	1.1	4.5	0.4	0.0	0.0	6.0
Total DOE project cost (TPC)	1.1	4.8	5.5	4.9	0.5	16.8
NSF MRI	0	0.2	0.1	0	0	0.3

Table 4: Funding profile for the MINERvA Project Based on the CSP in as year \$M. R&D costs incurred prior to CD-0 are not included.

## 9.5 Key Milestones and Events

Table 5 shows the tentative dates of the Critical Decisions. Table 6 shows the Level 3 Milestones and above. These milestone dates include schedule contingency.

Critical Decision	Description	Date
CD-0	Approve mission need	4 <sup>th</sup> Quarter FY2006
CD-1	Approve preliminary baseline range	1 <sup>st</sup> Quarter FY2007
CD-2	Approve project baseline	3 <sup>rd</sup> Quarter FY2007
CD-3	Approve start of construction	4 <sup>th</sup> Quarter FY2007

<b>CD-4</b>	Approve project closeout	4 <sup>th</sup> Quarter FY2010
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**Table 5: Critical Decisions for the MINERvA Project.**

<b>WBS</b>	<b>Milestone Name</b>	<b>Early</b>
1	L2 - Scintillator Shipping Complete	Dec-08
2	L2 - All Detector WLS Fibers Shipped To W&M	Jan-09
3	L2 - All Outer Detector Towers Shipped To Fermilab	Oct-09
3	L2 - All Inner Detector Planes Shipped To Fermilab	Dec-09
4	L2 - Detector ODU Shipments Complete	Sep-08
4	L2 - Detector Clear Fiber Cable Production Complete	Nov-09
5	L2 - 75% of PMT Boxes Complete	Sep-09
5	L2 - Finish Light Injection System For Full Detector	Feb-09
6	L2 - 75% of PMT's Shipped To Box Factories	Jul-09
7	L2 - Electronics Complete	Aug-09
8	L2 - Procurement of OD and Nuclear Target Production Materials Complete	Jul-09
9	L2 - All Modules Ready For Installation	Jan-10
10	L2 - MINERvA Tracking Prototype Detector Ready for Evaluation	Aug-08
10	L1 - MINERvA Detector Ready For Installation	Jan-10

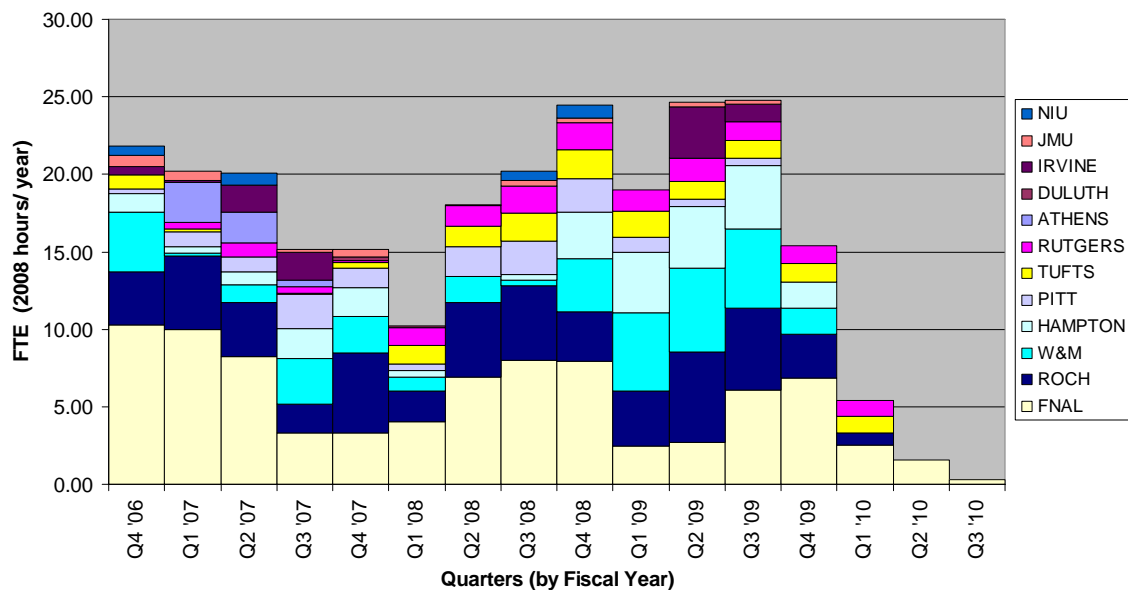
**Table 6: MINERvA Project Level 0 to Level 3 Milestones**

## **9.6 Personnel Resources**

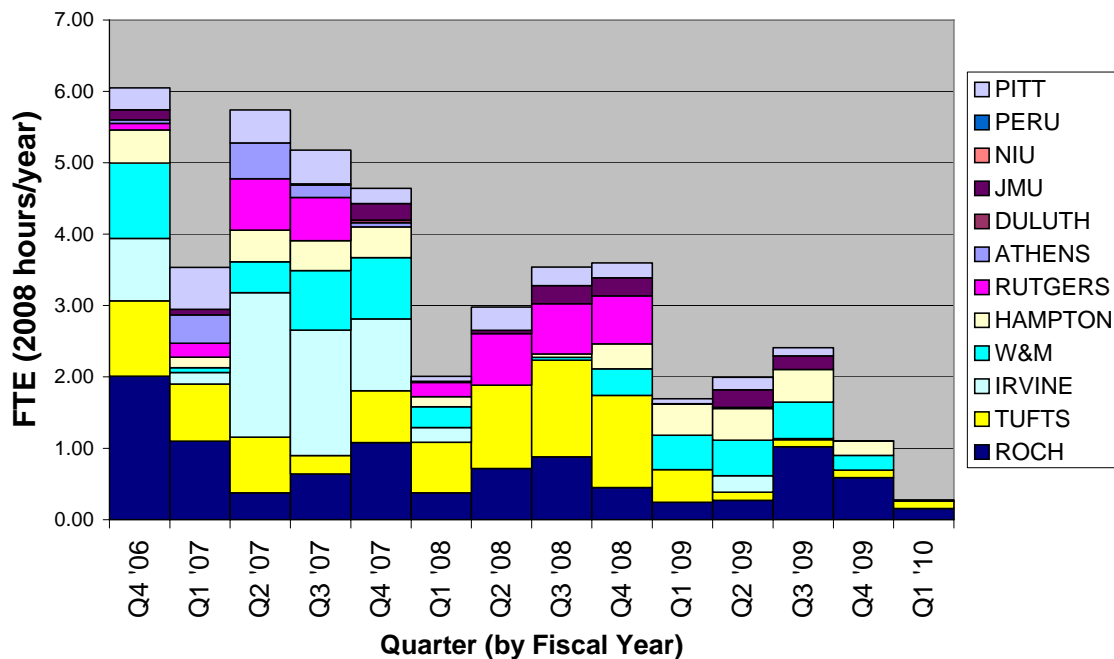
Currently there are 19 institutions and more than 70 physicists actively participating in the MINERvA Collaboration. The substantial physicist effort which is being provided by the collaborating institutions in support of the construction project is included in the CSP at no cost to the Project. Because institutional indirect cost rates may differ, all CSP cost estimates include each institutions' overhead G&A costs. Fermilab overhead is then applied to the institutional costs as if they were straight M&S costs. Universities with more than \$100K construction or R&D costs use an overhead of 1.5%. Those with less have a standard M&S overhead.

Figure 4 shows the costed labor profile as a function of fiscal year (by quarter), by institution. The increase of activity as the onset of construction fun availability is seen in the increase in FTE's around the second quarter of FY08.

Another important component of the labor profile from the MINERvA experiment comes from the non-costed labor: this includes physicists (graduate students or otherwise), or machine shop labor at universities, where the project must pay an M&S cost nominally for use of the machines. If some of this non-costed labor must be replaced by costed labor (for example, paying a technician to test phototubes instead of physicist labor) it would need to come out of the project. To prepare for this possibility, an additional amount of contingency has been allocated in the project management M&S funds, equal to roughly 20% of the non-costed FTE needs for each fiscal year. Figure 5 shows the non-costed labor profile (which does not include oversight) for the MINERvA experiment.



**Figure 4** Costed labor profile for the MINERvA experiment, in units of FTE's (assuming 2008 hours per year) and as a function of fiscal year by quarters.



**Figure 5** Non-costed labor for the MINERvA experiment as a function of fiscal year quarter. Non-costed labor here does not include oversight and management.